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ABSTRACT

The Beginning Teacher Evaluation Study (BTES), Phase II, was a research project on effective teaching behavior--what teachers do that significantly affects what and how pupils learn. The purposes of Phase II were to (1) develop an assessment system for measuring teacher and pupil behaviors and other factors which could influence each of them and their interrelationships and (2) generate hypotheses about the interrelationships among teacher and pupil behaviors and related factors. Forty-one second grade and 54 fifth grade experienced teachers participated in the study. This volume of the final report focuses on the relationship between teacher aptitudes and teacher behavior. A battery of 15 aptitude tests was administered to the second and fifth grade teachers participating in the study. Different factor structures were found for teachers at the two grade levels and were interpreted as verbal fluency, memory, reasoning, and flexibility. These four factors were entered into a path analysis to determine the direct effect of the aptitudes on teaching behavior. Aptitude-teaching behavior relationships appeared to be specific to either the grade level or to the subject being taught suggesting that teachers perceive the demand of these grades and subjects to be different and that they may select different teaching styles according to the demands of the instructional task. (RC)

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BEGINNING TEACHER EVALUATION STUDY
PHASE II 1973-74

FINAL REPORT

VOLUME V.1.

THE RELATIONSHIP OF TEACHER APTITUDES TO TEACHING BEHAVIOR

BY

RUTH B. EKSTROM

EDUCATIONAL TESTING SERVICE
PRINCETON, NEW JERSEY

BEGINNING TEACHER EVALUATION STUDY: PHASE II

FINAL REPORT: VOLUME V.1.

THE RELATIONSHIP OF TEACHER APTITUDES TO TEACHING BEHAVIOR

by

Ruth B. Ekstrom

Educational Testing Service
Princeton, New Jersey

A project conducted by Educational Testing Service for the California Commission for Teacher Preparation and Licensing and funded by the National Institute of Education.

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PREFACE

The Beginning Teacher Evaluation Study (BTES) is a long-term project of the California Commission for Teacher Preparation and Licensing. The Commission is resporsible for licensing teachers in California and is trying to determine what factors should be considered in this process.

The second phase of the study was conducted by Educational Testing Service for the Commission. Phase II was the hypotheses-generating and instrument-development phase of BTES. ETS had two tasks: (1) to develop an assessment system to measure both teacher and pupil behaviors as well as other factors which might be related to these behaviors; and (2) to generate hypotheses about the interrelationships between teacher and pupil behaviors and related factors.

The study was conducted in 43 schools in eight districts throughout the state of California. A total of 41 second grade teachers and 54 fifth grade teachers participated in the project during Phase II.

The final report for Phase II consists of several volumes. Volume I describes the design and rationale for the experimental design and data analysis procedures and includes the major findings of Phase II. Volume II describes the conduct of the field study and the sample of participants.

Because of the complex nature of Phase II, a variety of techniques was used to measure teacher and pupil behaviors. They are described in Volumes III, IV, and V. Results are also included in these volumes.

Volume III describes the observation systems in detail and is available in three separately bound sections. The first section, Volume III.1., describes the behavior recording observation system used in the project--APPLE (Anectdotal Process for Promoting the Learning Experience). Volume III.2. describes the category system used to observe classroom activities--

RAMOS (Reading and Mathematics Observation System). The third section of this volume, III.3., covers the videotaping of instructional activities during reading and mathematics.

Volume IV concerns other aspects of the measurement system and covers both the pupil and teacher test batteries.

The fifth volume covers a series of small studies done as part of Phase II. Volume V.1. looks at teacher aptitudes as related to teacher behaviors. Volume V.2. is concerned with the relationship between teacher expectations and pupil performance. Volume V.3. reviews performance of pupils in the BTES teachers' classrooms for two years prior to Phase II, the historical test data. Volume V.4. discusses the Diagnostic Film Test, a device designed to assess teachers' skills in diagnosing reading problems and prescribing corrective action. Volume V.5. summarizes the results of work diaries completed by the teachers on their reading and mathematics instructional program.

Information on the availability of these volumes can be obtained from:

Dr. Frederick J. McDonald
Educational Studies
Educational Testing Service
Princeton, NJ 08540

Information on other phases of BTES can be obtained from:

California Commission for Teacher
Preparation and Licensing
1020 O Street
Sacramento, CA 95814

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A special word of appreciation is due to the BTES teachers for the time they devoted to taking the series of aptitude tests in the fall and spring of 1973-74.

Ruth Ekstrom

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The Relationship of Teacher Aptitudes to Teaching Behavior

This report deals with one aspect of a large study investigating the relationship between teacher characteristics and pupil learning. The current project focuses on teacher variables which enhance the learning of reading and mathematics by children in grades two and five of California elementary schools.

The design for this study deals with pupil learning as a function of many variables. These include pupil characteristics such as aptitude, classroom behavior, attitude, and expectations; they also include teacher variables such as aptitude, knowledge, attitudes, expectancies, and teaching behavior and also the impact of the organizational climate of the school. In this chapter we shall focus on that portion of the study which deals with the relationship between teacher aptitudes and teacher behavior.

The Conceptual Model and Its Implications

The conceptual model for this study has as its basic premise the idea that differences in pupil learning are the result of differences in pupil classroom behavior and that these, in turn, are determined not only by the pupil variables mentioned above but also by different teaching behaviors. We expected that teaching behaviors would be influenced directly by differences in teacher aptitudes and that the aptitudes would also affect teaching behavior indirectly through differences in teacher knowledge. (This model is shown in Figure 1.) The relationship between teacher aptitude, knowledge and behavior is based on transfer of training theory, in general, and, more specifically, on the model of

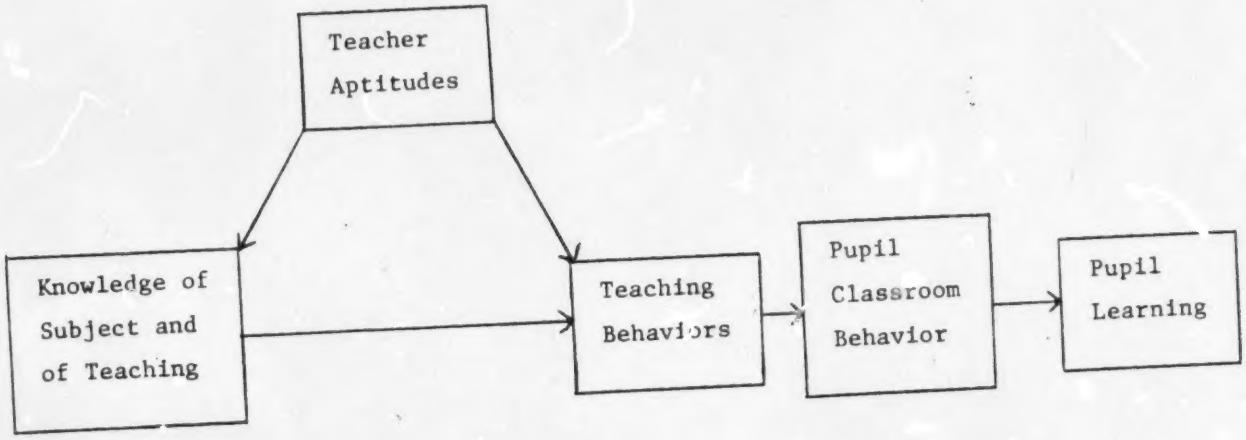

Figure 1. The hypothesized relationship between pupil learning and teacher aptitudes, knowledge.

hierarchical learning sets (Gagne, 1962, 1970). We also theorize that there are some minimal aptitude levels which are necessary but not sufficient to produce the knowledge and behaviors necessary for adequate teaching performance.

Rationale. In developing the model and the test battery we tried to analyze the basic skills necessary for both teacher knowledge and teaching behavior. Earlier research suggested some important relationships between teacher aptitude and pupil achievement. Additionally, various models of the structure of intellect (Guilford, 1967; Carroll, 1974) and reviews of cognitive factors (e.g., Ekstrom, 1973) suggested other relationships between aptitudes and teaching behavior. It was decided that verbal ability, reasoning ability, memory, fluency, and flexibility would be important aptitudes for teachers.

Verbal aptitude was included not only because of its importance in earlier research but also because of the obvious relationship between this ability and the teacher's own reading skills. It is also fairly clear that teacher verbal ability is an important element in teacher to pupil communications. This aptitude is probably what is referred to as cognition of semantic units in Guilford's model. Carroll (1974) points out that long-term lexicosemantic memory is usually involved in tests measuring verbal aptitude. He points out that the algorithms and operations involved in tests for this and many other cognitive factors are related to many kinds of school learning.

Quantitative reasoning aptitude seemed likely to have the same relationship to mathematic skills as verbal aptitude has to reasoning

skills. A skill closely related to quantitative aptitude, numerical facility, is treated in this study as teacher knowledge rather than aptitude. This decision can certainly be argued but the correlation of .37 between the measures selected for these two related areas suggests that these are not merely different names for the same skill (Ekstrom, 1974). While both involve long-term memory, in quantitative reasoning aptitude, as measured by the Mathematics Aptitude Test used in this study, abstract logical algorithms are retrieved rather than the number associations required in numerical facility tasks such as doing simple, near mechanical, computations. In the Guilford model, numerical facility is considered to be memory for symbolic implications while quantitative aptitude is described as cognition of semantic systems.

Two other aptitudes which are likely to be important in both mathematics and reading comprehension are logical and inductive reasoning. Not only is logical reasoning of fundamental importance in mathematics, it also plays an important role in reading, both in relation to developing the letter-sound correspondence important in decoding and in coping with the kinds of multiple-choice test items often used in measuring reading comprehension. In teacher performance, the importance of logical reasoning, as measured by the Nonsense Syllogisms test in this study, ranges from deciding which instructional approach will best meet a pupil's needs to deciding who most likely threw that spitball, while inductive reasoning should be helpful in conceptualizing as a group the indicators of need for different types of remediation. In the Guilford model, inductive reasoning is considered to include the cognition of symbolic and figural

classes and systems while logical reasoning requires the evaluation of semantic relations. Carroll points out that logical reasoning requires retrieving the appropriate meanings and algorithms from long-term memory and then performing serial operations on them (a process similar to that required in quantitative aptitude) while induction requires a search through long-term memory for hypotheses and serial operations to construct new hypotheses. Given the all-pervasive relation between reasoning and teacher performance, we hypothesized that this aptitude might be at least as significant as verbal aptitude.

Memory was selected as another important teacher aptitude because of its basic relationship to most other cognitive factors. Additionally, the ability to recall the correct piece of information when it is needed seems basic in teaching performance. It was thought that, by including memory as a separate aptitude as well as other aptitudes which are partially dependent on memory, it might be possible to differentiate the relevant aptitude subcomponents more exactly. Two types of memory were included in this study: (1) associative memory, or the ability to remember bits of unrelated material, and (2) meaningful memory, or the ability to remember verbal material. Guilford defines meaningful memory as memory for semantic systems while associate memory is memory for symbolic units.

Each of the four aptitudes discussed above: (1) verbal, (2) quantitative, (3) reasoning, and (4) memory was an aptitude included in the pupil aptitude instrument as well as being a part of the teacher aptitude battery. Although the tests used for teachers and pupils were quite different, it was hoped that this similarity

would allow for a basic exploration of the degree to which teacher-pupil aptitude matches or mismatches might affect teacher-pupil interaction in terms of both teacher performance and pupil achievement.

The remaining teacher aptitudes are those kinds of divergent production sometimes called creativity.

Fluency is one of the most important divergent production aptitudes. Three kinds of fluency were included in this study. Research by Calvin Taylor and his colleagues (1967) has already shown the importance of associational and expressional fluency in relation to the ability to instruct others. Associational fluency involves the ability to produce words from a restricted area of meaning while expressional fluency involves the ability to think of word groups or phrases. Obviously, both are probably important in the oral presentation of material and may be especially important in rephrasing material so it is most appropriate for a particular pupil. Ideational fluency is the ability to think of many ideas to a given stimulus. Taylor found that individuals scoring in the mid-range on tests of this type were more effective communicators than those scoring at the extremes. These three fluency factors are described by Guilford as requiring the divergent production of relations, systems, and units. Carroll points out that associational and expressional fluency require searching long-term memory for appropriate lexicosemantic or lexicogrammatic instances while ideational fluency involves searching experimental memory for appropriate associations.

Semantic originality, which is defined as the ability to produce remotely associated, clever, or uncommon verbal responses to a stimulus,

probably relates to teacher performance in much the same way as does ideational fluency. It seems plausible that the ability to think of remote relationships would be optimal at the mid-range for the elementary school teachers in this study (although it might be important to have higher levels of ideational fluency and originality in teacher-scholars at the university level). However, an argument could be made that teachers working with pupils having learning difficulties or coming from a different culture might be more successful if the remote relationships were more psychologically available to them. Semantic originality is described by Guilford as divergent production of semantic transformations. Carroll points out that it requires searching long-term experimental memory for unusual instances.

Two other aptitude factors selected for this study involve the ability that is popularly known as flexibility. They are spontaneous semantic flexibility, or the ability to produce diverse ideas, and semantic redefinition, the ability to think of new or different uses for objects (probably this is the polar opposite of functional fixedness). Both of these aptitudes require what is often referred to as the ability to change a mental set. It was hypothesized that these aptitudes would relate to a teacher's ability to shift to different explanations or methods when the more common approach did not seem to work. Student teachers who are flexible have been found better able to help pupils think for themselves (Hunt and Joyce, 1967). Guilford describes these aptitudes as divergent production of semantic classes and convergent production of semantic transformations. However, as was pointed out by Ekstrom (1973), these aptitudes have

combined in studies outside the Guilford laboratory. Carroll has pointed out that both involve the searching of long-term experimental memory for associations.

The concept of flexibility may also be related to several of the other factors. For example, the flexibility and breadth with which a word is defined may determine the number of words associated with it, as in the Controlled Associations Test, or the willingness to accept unusual appearing explanations for an occurrence may determine the number of remote possibilities entertained, as in the Story Surprises Test. These tests are described in the next section.

The last of the aptitude factors selected for this battery was sensitivity to problems, the ability to recognize problems. It was hypothesized that this factor would relate to teachers' abilities in general classroom management as well as their ability to detect pupil learning and behavioral difficulties. Guilford defines this factor as cognition or evaluation of semantic implications. As Carroll has described this factor, it involves the use of both experimental and abstract logical long-term memory to retrieve associations.

Test Battery

The teacher aptitude battery used in this study consisted of 15 tests measuring: (1) verbal aptitude, (2) general reasoning, (3) inductive and logical reasoning, (4) associative and meaningful memory, (5) associational, expressional, and ideational fluency, (6) semantic originality, (7) semantic redefinition, (8) sensitivity to problems, and (9) spontaneous semantic flexibility.

Most of the tests selected for use with the teachers in this study were adaptations of instruments in the Educational Testing Service's Kit of Reference Tests for Cognitive Factors (Educational Testing Service, 1963) or of similar measures being developed for the 1976 revision of this kit. The reason for this was that these tests are designed to be essentially univocal measures of a single aptitude. Thus, each test measures only one aptitude with an essentially homogeneous set of items and is relatively independent of the other aptitude measures. Two tests used in the study were not taken from the Factor Kit. One was the meaningful memory measure, the Sentence Completion Test, which had been developed in other research at Educational Testing Service. The other was the verbal ability test which had been developed by Educational Testing Service for the Coleman study. It seemed particularly important to include this latter instrument to serve as a "marker" measure so that the findings of this study could be related to other research using this same test as an index of teacher verbal ability. As the later analyses will show, its inclusion in this more complex battery has provided data which suggests that this instrument is much more nearly a measure of verbal reasoning than a simple vocabulary test explaining, perhaps, why some researchers have found teacher scores on the Coleman study test to be more highly correlated with pupil achievement in mathematics than with achievement in reading. (Intercorrelations among the Teacher Aptitude Tests are shown in Table 1.)

Table 1

Intercorrelations Among Teacher Aptitude Tests

(Grade 5 above diagonal; grade 2 below)

		701	702	712	713	714	715	717	721	724	725	726	727	728	729	730
701	Verbal Facility (Coleman)	-	.52	.13	.32	.11	.50	.42	.51	.35	.29	.46	.33	.35	.21	.30
702	Vocabulary	.52	-	.05	.27	-.09	.37	.26	.41	.05	.44	.38	.52	.42	.26	.37
712	Associative Memory	.36	.37	-	.20	.07	.26	.30	.20	.43	.10	.29	.13	.17	.23	.14
713	Picture Grouping	.25	.15	.30	-	.05	.57	.39	.35	.29	.20	.42	.24	.37	.29	.24
714	Nonsense Sayings	.33	.14	-.04	.35	-	.04	.29	-.08	.09	.22	.20	-.08	.09	.01	-.02
715	Inductive Reasoning	.29	.24	.35	.25	.45	-	.46	.58	.35	.21	.55	.47	.50	.39	.48
717	Mathematics Aptitude	.46	.42	.28	.37	.31	.48	-	.37	.16	.33	.59	.33	.35	.23	.39
721	Finding Useful Parts	.57	.38	.48	.26	.25	.29	.31	-	.36	.34	.37	.41	.33	.29	.40
724	Sentence Completion	.53	.47	.60	.37	.30	.31	.36	.47	-	.00	.19	.33	.24	.37	.27
725	Topics Test	.24	.17	.20	.08	-.13	.20	.48	.17	.13	-	.30	.32	.56	.39	.16
726	Story Surprises	.50	.29	.21	.19	.14	.27	.54	.31	.41	.07	-	.37	.45	.30	.40
727	Controlled Associations	.27	.36	.33	.19	.21	.35	.39	.19	.19	.25	.16	-	.46	.36	.44
728	Making Sentences	.28	.44	.09	-.16	.10	.32	.26	.28	.08	.17	.48	.11	-	.50	.47
729	Listing Objects	.21	.18	.22	.20	.27	.40	.26	-.03	.25	.18	.17	.41	.04	-	.19
730	Planning Test	.38	.28	.19	.24	.35	.39	.37	.51	.31	.18	.38	.09	.52	-.12	-

The tests used were:

Verbal Aptitude:

701 Verbal Facility. This is the verbal ability measure used in the Coleman study. The subject is asked to select from five options the best word to be used in a blank to complete a sentence.

702 Vocabulary (V-4). The subject is asked to select from five options the word that is the best synonym for a stimulus word.

Associative Memory:

712 Associative Memory (MA-1). The subject is asked to recall the two digit number which has been paired with a picture on a study page.

Inductive Reasoning:

713 Picture Grouping (I-3). The subject is asked to determine the rule or reason which determines the assignment of simple figures to two or three groups and then to indicate to which group additional figures should be assigned.

715 Inductive Reasoning (I-1). The subject is asked to determine the rule which relates four groups of four letters and to mark the fifth and unrelated group.

Logical Reasoning:

714 Nonsense Syllogisms (RL-1). The subject is asked to indicate if the conclusion drawn from two preceding statements shows good or poor reasoning.

General Reasoning:

717 Mathematics Aptitude (RG-2). The subject is asked to select from five options the correct answer to simple work problems which stress reasoning and include some algebra.

Semantic Redefinition:

721 Finding Useful Parts (RE-1). The subject is asked to select from five options the one object that could be used for a specified purpose when the usual object for that purpose is unavailable.

Meaningful Memory:

724 Sentence Completion. The subject is asked to recall from a sentence previously studied the word which has been omitted.

Ideational Fluency:

725 Topics Test (FI-1). The subject is asked to write as many ideas as possible about a given topic.

Semantic Originality:

726 Story Surprises (O-1). The subject is asked to write two different and surprising endings for a short story.

Associational Fluency:

727 Controlled Association (FA-1). The subject is asked to write as many synonyms as possible for each of several given words.

Expressional Fluency:

728 Making Sentences (FE-1). The subject is asked to write sentences when the first letter of most of the words is given.

Spontaneous Semantic Flexibility:

729 Listing Objects (XS-3). The subject is asked to list as many things as possible that might be found in a specified setting.

Sensitivity to Problems:

730 Planning Test (Sep-1). The subject is asked to indicate what is wrong with each of several plans for solving different problems.

This test battery was administered to 41 second grade teachers and 54 fifth grade teachers. All of the teachers were volunteers who agreed to participate in the study and each had three or more years of teaching experience. The group consisted of 18 males and 77 females from eight different California school districts which represented urban, suburban and rural communities. Additional information on the sample is given in Volume II.

Factor Analysis

Because the time available for testing was limited, it was not possible to include enough tests for each aptitude in the teacher test battery to allow the aptitudes to emerge as separate primary factors. Consequently, the factors in this analysis can be best conceptualized as the kind of higher-order or second-stratum factor produced by closely related primary aptitudes.

Although there was no reason to expect different aptitude patterns for different teaching levels, it was decided to keep the analysis for the teachers at each grade level separate until it could be demonstrated that the resulting factors for teachers at each grade level were essentially congruent. To estimate the number of factors in the test battery, unity was inserted in the diagonal of the correlation matrix and the number of roots greater than one computed. For both grade 2 and grade 5 teachers, there were four roots of this magnitude accounting for 63% of the variance. Principle components were computed and both varimax and oblimin rotations obtained. The resulting factors (shown in Table 2) were distinctly different at the two grade levels, irrespective of methodology.

Table 2

Initial Factor Analyses of Teacher Aptitude Tests

(Loadings of .30 or larger)

		Grade 2 Factors					Grade 5 Factors				
		I	II	III	IV	h^2	I	II	III	IV	h^2
701	Verbal Facility (Coleman)	.61		.43		.61	.76				.61
702	Vocabulary	.55		.34		.50	.61			.49	.66
712	Associative Memory	.79				.69			.72		.57
713	Picture Grouping	.45			.55	.56	.46		.35		.40
714	Nonsense Sayings				.85	.81		.84			.72
715	Inductive Reasoning		.53	.38	.41	.60	.70				.67
717	Mathematics Aptitude		.57	.45		.63	.55	.57			.67
721	Finding Useful Parts	.68		.41		.66	.67				.55
724	Sentence Completion	.79				.71			.80		.71
725	Topics Test		.53		-.42	.53				.81	.78
726	Story Surprises			.61		.49	.60	.64			.63
727	Controlled Associations		.71			.55	.53			.47	.56
728	Making Sentences			.86		.77	.37			.71	.68
729	Listing Objects		.77			.66			.46	.71	.72
730	Planning Test			.75		.71	.73				.55

The aptitude factors for the second grade teachers were interpreted as:

I. Meaningful Memory -- the ability to remember meaningful relationships. Both the memory tests and the verbal ability tests loaded on this factor.

II. Flexibility in Reasoning -- the ability to change set so as to facilitate problem solving. Tests for flexibility, associated and ideational fluency, inductive reasoning, and mathematics aptitude loaded on this factor.

III. Verbal Productivity -- the ability to produce several written responses to a stimulus. Tests of expressional fluency, originality, and sensitivity to problems had major loadings.

IV. Reasoning -- the ability to solve problems which require fairly formal reasoning processes. The tests loading on this factor require inductive or syllogistic reasoning.

The aptitude factors for the fifth grade teachers were interpreted as:

I. Verbal Reasoning -- the ability to solve verbal problems. The tests with the largest loadings on this factor include the measures of verbal ability, inductive reasoning, sensitivity to problems, and redefinition.

II. Nonverbal Reasoning -- the ability to solve problems by formal, mathematical processes. This factor is similar to the reasoning factor found for second grade teachers but it excludes inductive reasoning and has major loadings on tests of mathematical aptitude and syllogistic reasoning.

III. Memory -- essentially a doublet factor composed of the associative and meaningful memory tests.

IV. Verbal Restructuring -- or divergent semantic production. The tests loading on this factor require fluency and flexibility in producing many different verbal responses.

However, the complexity of the design for the total st dy made it highly desirable to obtain a single set of factors which would be comparable at the two grade levels. Therefore several different approaches were tried to obtain such a structure. Attempts to obtain comparable factors by alternate methods of factoring and rotation were not successful. Consequently, it was decided to use a modification of the hypotheses presented in the rationale section about the structure of teacher aptitudes as a target and to rotate the obtained solutions to this. The resulting factors (shown in Table 3) all had coefficients of congruence over .90 with a target and were comparable for the two grade levels. These factors were interpreted as:

I. Verbal Fluency -- the ability to use words skillfully.

II. Memory

III. Reasoning -- the ability to solve problems requiring inductive, syllogistic and mathematical reasoning.

IV. Flexibility -- the ability to change set.

Table 3

Targeted Factor Analysis of Teacher Aptitude Tests

(Loadings of .30 or larger)

		Grade 2 Factors				Grade 5 Factors				Factor Target			
		I	II	III	IV	I	II	III	IV	I	II	III	IV
701	Verbal Facility (Coleman)	.70				.69				1.00			
702	Vocabulary	.68				.73				1.00			
712	Associative Memory		.88				.83				1.00		
713	Picture Grouping			.67				.66				1.00	
714	Nonsense Sayings			.72				.58				1.00	
715	Inductive Reasoning			.72			.32	.71				1.00	
717	Mathematics Aptitude	.31		.71				.73				1.00	
721	Finding Useful Parts				.72				.73				1.00
724	Sentence Completion		.89				.86				1.00		
725	Topics Test	.60				.68				1.00			
726	Story Surprises				.70				.72				1.00
727	Controlled Associations	.60				.71				1.00			
728	Making Sentences	.63				.74				1.00			
729	Listing Objects				.52				.66				1.00
730	Planning Test				.73				.71				1.00
		Coefficients of Congruence				Coefficients of Congruence							
		.91	.95	.93	.91	.92	.97	.93	.91				

The reason for the differences in the aptitude patterns for the teachers at the two grade levels is not entirely clear. One hypothesis is that individuals may select different teaching levels because of different preferred cognitive strategies. For example, the primary grades, where basic skills require considerable drill may be selected by those individuals whose preferred strategy is memory lookup while the intermediate grades, where content subjects become more important, may be more attractive to those individuals preferring analytic reasoning strategies. Conversely, it is possible that the teaching emphases at these two grade levels produce a tendency in these experienced teachers to prefer these different strategies.

Relating the Aptitudes to Teacher Behavior

These four teacher aptitude factors were entered into a path analysis along with other teacher variables (personal characteristics, knowledge of teaching, knowledge of subject, attitude toward teaching, and cognitive style) to determine their effect on different teaching behaviors. The teaching behaviors were, in turn, related to pupil behavior and pupil learning.

The teaching behaviors were obtained from the teacher Work Diaries (described in Volume V. 5.) and from two different classroom observation systems: (1) APPLE, developed by Dr. Nadine Lambert of the University of California at Berkeley (see Volume III. 1.), and (2) RAMOS, developed by Dr. Robert Calfee of Stanford University (see Volume III. 2.). The pupil behaviors were also obtained from the APPLE observation system. Pupil learning was computed as fall

to spring growth on a series of measures including a norm-referenced measure, the California Achievement Test, and several domain referenced measures including tests of Reading Achievement, Decoding, Reading Application and Mathematics Application which were developed for this project. The tests are described in Volume IV. A brief summary of the teacher behavior variables is presented in Table 4.

Path coefficients between the teacher aptitudes and the teaching behaviors are shown in Table 5 and described in Tables 6, 7, 8, and 9. These data are based on those teachers who taught reading or mathematics to ten or more pupils at the specified grade levels. Thus the number of teachers is not exactly equivalent to the total group tested.

Although no teacher aptitude was found to be consistently and significantly related to a teaching behavior for both grade levels and for both subject areas, several behaviors approached this consistently. In particular, quality of teaching methodology (WD-3) seems to be positively related to teachers' verbal fluency and negatively related to their reasoning ability. Flexibility appears to be negatively related to both organizing (AP-8) and to instructional responsiveness to pupils (AP-12).

In general, however, the aptitude-teaching behavior relationship appears to be specific to either the grade level or to the subject being taught. This is not surprising if teaching is not a homogeneous task where a few instructional behaviors are equally appropriate and effective for all ages of students and for all subject areas. If teachers perceive the need to react differently

Table 4

Teaching Behaviors

I. Instructional Time
- Work Diary 1 - Amount of time spent preparing for and teaching reading or mathematics
- RAMOS 1 - Variety of instructional roles (high score implies more time in instructional and facilitating roles)

II. Instructional Content
- Work Diary 2 - Variety of skills taught
- Work Diary 3 - Quality of teaching methodology
- RAMOS 2 - Variety of instructional aims or purposes

III. Instructional Materials
- Work Diary 5 - Number of types of materials used
- RAMOS 3 - Variety of materials used

IV. Instructional Organization
- Work Diary 4 - Complexity of managerial structure in the classroom
- APPLE 5 - Pupils work independently of teacher
- APPLE 6 - Teacher directs pupils working in groups
- APPLE 7 - Teacher works with whole class

V. Instructional Activity
- RAMOS 4 - Time spent in instructional activities
- APPLE 8 - Organizing and facilitating the instructional process
- APPLE 9 - Unsustained behaviors monitoring the progress of pupils
- APPLE 10 - Sustained behaviors to enhance pupil understanding
- APPLE 11 - Location of teacher in the classroom (high score implies greater mobility)

VI. Teacher-Pupil Interaction
- APPLE 12 - Instructional responsiveness to individual pupils
- APPLE 13 - Responses for social control or management of pupil behavior
- APPLE 14 - Nonresponsiveness to individual pupils

Table 5

Significant* Path Coefficients from Teachers' Aptitudes to Their Classroom Behaviors in Teaching Reading and/or Mathematics

	Instructional Behaviors																		
	Time		Content			Materials		Organization				Activity					Interaction		
	TP1	P1	WD2	WD3	R2	WD5	R3	WD4	AP5	AP6	AP7	R4	AP8	AP9	AP10	AP11	AP12	AP13	AP14
Grade 2 Teachers																			
Reading (n=40)																			
Verbal Fluency	--	--	--	.33	--	--	--	-.55	.36	.48	--	--	--	--	--	--	.49	--	-.37
Memory	--	--	--	.57	--	--	.53	--	--	--	--	.39	--	--	--	-.37	.33	--	.32
Reasoning	--	--	--	--	--	-.78	--	--	--	--	--	--	--	.66	--	--	--	--	--
Flexibility	--	--	.38	-.43	--	.78	-.46	.52	-.92	-.49	.34	--	-.48	--	--	.34	--	--	--
Mathematics (n=41)																			
Verbal Fluency	--	--	--	--	--	--	--	--	--	.32	--	--	--	--	-.33	--	--	.71	--
Memory	--	--	--	--	--	-.46	--	-.50	--	.51	--	.35	--	--	.51	--	.46	--	--
Reasoning	--	.56	.42	-.99	--	--	.46	.41	--	--	--	--	--	.32	--	--	--	--	--
Flexibility	.59	--	.36	--	--	.40	-.40	.99	-.65	-.68	.86	--	-.36	--	--	--	-.36	--	--
Grade 5 Teachers																			
Reading (n=53)																			
Verbal Fluency	--	--	.47	.71	-.44	-.73	--	--	.41	-.29	--	--	.63	.31	--	-.43	--	--	--
Memory	-.33	--	--	--	--	--	--	-.34	--	--	--	--	--	--	--	--	--	--	--
Reasoning	-.29	--	-.30	-.40	--	--	--	-.54	.30	--	--	--	--	-.39	--	.28	--	.49	--
Flexibility	--	--	--	-.58	--	--	--	.31	--	--	-.37	--	-.50	--	-.29	--	-.52	--	--
Mathematics (n=54)																			
Verbal Fluency	--	--	.53	--	--	-.32	--	.45	--	--	--	--	--	--	.28	--	--	-.36	--
Memory	--	--	--	--	--	--	--	--	.28	--	--	--	--	.42	--	--	.34	-.29	.28
Reasoning	-.35	--	-.36	-.51	--	--	--	--	--	--	--	--	--	--	--	.47	--	--	--
Flexibility	--	--	--	-.38	--	.29	--	--	--	--	--	--	--	-.39	--	--	--	.71	-.40

*Coefficients significant at or beyond .05 level

Table 6

Teaching Behaviors Significantly Related to Verbal Fluency

Specific for:		
Reading		
Quality of teaching methodology	(+)	WD-3
Independent pupil work	(+)	AP-5
Mathematics		
None		
Grade 2		
Works with groups	(+)	AP-6
Grade 5		
Variety of skills taught	(+)	WD-2
Variety of materials used	(+)	WD-5

(+ = positive relationship between aptitude and behavior; - = negative relationship)

Table 7

Teaching Behaviors Significantly
Related to Memory

Specific for:		
Reading		
None		
Mathematics		
Direct instructional responsiveness	(+)	AP-12
Grade 2		
Individual pupil seatwork	(+)	R-4
Direct instructional responsiveness	(+)	AP-12
Grade 5		
None		

(+ = positive relationship between aptitude and behavior; - = negative relationship)

Table 8

Teaching Behaviors Significantly
Related to Reasoning

Specific to:		
Reading		
None		
Mathematics		
Quality of teaching methodology	(-)	WD-3
Grade 2		
Monitoring of pupil understanding	(+)	AP-9
Grade 5		
Variety of skills taught	(-)	WD-2
Quality of teaching methodology	(-)	WD-3
Teacher mobility	(+)	AP-11

(+ = positive relationship between aptitude and behavior; - = negative relationship)

Table 9

Teaching Behaviors Significantly
Related to Flexibility

Specific to:		
Reading		
Quality of teaching methodology	(-)	WD-3
Complexity of managerial structure	(+)	WD-4
Organizing and facilitating instruction	(-)	AP-8
Mathematics		
Variety of materials used	(+)	WD-5
Grade 2		
Variety of skills taught	(+)	WD-2
Variety of materials used	(+)	WD-5
Variety of instructional materials used	(-)	R-3
Complexity of managerial structure	(+)	WD-4
Independent pupil work	(-)	AP-5
Teaching in groups	(-)	AP-6
Work with whole class	(+)	AP-7
Organizing and facilitating instruction	(-)	AP-8
Grade 5		
Quality of teaching methodology	(-)	WD-3

(+ = positive relationship between aptitude and behavior; - = negative relationship)

in dealing with different types of students or different instructional areas, we should not expect to find consistent relationships between teacher aptitudes and teaching behaviors.

Verbal fluency, as shown in Table 6, is significantly and positively related to the quality of teaching methodology and the use of independent pupil work in reading instruction. Fluency does not show significant relationships with mathematics instruction. At the second grade level, fluency is positively related to preferring to work with pupils in groups (as opposed to instructional organization involving the whole class or independent pupil work). At fifth grade, fluency is positively related to the variety of skills taught (WD-2) and to the variety of materials used (WD-5).

Memory has relatively little impact on the teaching behaviors. However, it is positively related to direct instructional responsiveness in teaching mathematics at both grades and in instruction in grade 2. Memory is also positively related to the use of individual pupil seatwork in grade 2.

The reasoning factor is not related to reading instruction. Surprisingly, this factor shows negative paths to the quality of teaching methodology in mathematics and at grade 5. It is also negatively related to the variety of skills taught in grade 5. The monitoring of pupil understanding in grade 2 and teacher mobility in grade 5 are positively related to the reasoning factor.

Flexibility proved to be the teacher aptitude factor which has the largest number of significant paths to teaching behavior. At the second grade level, this effect is particularly noticable.

Every teaching behavior in both the Materials and Organization categories is significantly related to the flexibility factor for grade 2 teachers. The pattern of relationships between flexibility and second grade classroom organization shows that more flexible teachers utilize a more complex classroom organization (WD-4), which implies they are more likely to have the sole responsibility for instruction. These more flexible teachers tend to teach the whole class (AP-7) rather than to have independent pupil work (AP-5) or to do instruction in groups (AP-6). This is interpreted to indicate that more flexible teachers are better able to respond differently to pupils without having to resort to using organizational strategies (such as aides or grouping) to produce this individualization. Flexibility in grade 2 teachers is also positively related to the variety of skills taught and is negatively related to organizing and facilitating instruction. At grade 5 and in the teaching of reading, flexibility is negatively related to the quality of teaching methodology. Flexibility is also negatively related to organizing and facilitating reading instruction. The variety of materials used in the teaching of mathematics is positively related to flexibility.

Summary and Conclusions. A battery of 15 aptitude tests was administered to 41 second-grade and 54 fifth-grade teachers who were participating in a study investigating the relationship between teacher characteristics and pupil learning. Different factor structures were found for teachers at the two grade levels. A targeted factor solution produced four comparable factors for the

two grades with coefficients of congruence over .90. These four factors were interpreted as verbal fluency, memory, reasoning, and flexibility. These four factors were entered into a path analysis to determine the direct effect of the aptitudes on teaching behavior.

Aptitude-teaching behavior relationships appeared to be specific to either the grade level or to the subject being taught. This suggests that teachers perceive the demands of these grades and subjects to be different and that they may select different teaching styles according to the demands of the instructional task.

The most dramatic aptitude-teaching behavior interaction was found between the flexibility factor and the four teaching behaviors related to instructional organization in grade 2.

These data suggest that further exploration of the predictability of teaching behaviors from teacher aptitudes would be promising.

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